Evaluation of the Extent to Which Massachusetts General Hospital Emergency Department Triage of Transient Ischemic Attack Patients Aligns With Virtual TIA Clinic Protocol: A Pilot Cross-Sectional Medical Record-Review to Inform Care Redesign Efforts

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Glossary of Abbreviations

$ABCD^2$: Age – Blood Pressure – Clinical Presentation – Duration of Symptoms - Diabetes History

CAS: Clinical Applications Suite

CT: computed tomography

CTA: computed tomography angiography

DWI: diffusion-weighted imaging

ED: emergency department

EMR: electronic medical record

EXPRESS: Effect of Urgent Treatment of Transient Ischaemic Attack and Minor Stroke on Early Recurrent Stroke

IC: internal carotid

ICD-9: International Classification of Diseases, version 9

LMR: Longitudinal Medical Record

MEEI: Massachusetts Eye and Ear Infirmary

MGH: Massachusetts General Hospital

MR: magnetic resonance

MRA: magnetic resonance angiography

QPID: Queriable Patient Interface Dossier

TIA: transient ischaemic attack

US: ultrasound

Section 1: Introduction

Stroke and other cerebrovascular disease account for more deaths worldwide than any other medical condition, save ischaemic heart disease.[1] In 2009, the most recent year for which finalized data had been available upon completion of the project which is the subject of this report, almost 130,000 succumbed to these conditions in the United States alone.[2] Preliminary data for 2011, the latest now available, show that the threat persists, with a similar number of deaths in this category.[3] As staggering as the death-toll is the projected cost of stroke care over the coming decades, estimated to number in the trillions of dollars before 2050.[4]

While long-term treatments have existed for many years that are effective in preventing stroke recurrence after a transient ischaemic attack (TIA) or minor stroke, more recent studies have called for more research on the acute treatment phase to reduce morbidity, mortality, and costs.[5 6 7 8 9 10] The Antithrombotic Trialists Collaboration, for example, established in 2002 that, while low-dose aspirin has protective effects in the long run, acute events call for a higher loading dose and, possibly, the addition of a second antiplatelet agent, data on which are lacking.

The shift has been driven by observations that roughly one in ten will suffer a recurrent stroke within just one week following TIA or minor stroke.[11 12 13] Indeed, half of these occur within just twenty-four hours of the index event, as observed by Chandratheva et al.[14] Encouragingly, Luengo-Fernandez et al established in the EXPRESS trial by way of prospective population-based sequential comparison that efforts to treat patients urgently in a specialty outpatient setting reduced hospital bed-days, acute costs, and 6-month disability.[15]

To determine which patients may be managed safely on an outpatient basis rather than admitted, we turn to the now well-known ABCD^2 scoring algorithm, which assesses a patient's risk for recurrent stroke based on age, blood pressure, clinical presentation, duration of symptoms, and diabetic status. As discussed by Rothwell et al in a Lancet Neurology review published in 2006, evidence supports the use of scores like this one to predict the risk of recurrent stroke, particularly in the first 12- and 24-hour intervals, making it a useful tool for emergency department (ED) triage.[13] However, the score has not been shown to correlate strongly with the raft of diagnostic studies that often comprise a stroke work-up, a disappointing inconsistency demonstrated by Schrock et al in a study published just a few years later.[16] For this reason, it remains a useful adjunct tool, rather than a replacement for these.

These findings underpin the Partners HealthCare stroke care redesign initiative, part of a broader care redesign project consisting of a multitude of internal process improvement studies in different clinical specialty areas. The stroke care redesign initiative includes the implementation of a "Virtual TIA Clinic" to ensure rapid outpatient follow-up with TIA patients determined to be suitable for such a care pattern. Internal financial analyses conducted at the Massachusetts General Hospital (MGH) had shown that inpatient stays represented the bulk of costs associated with TIA/stroke patients, motivating the development of strategies to reduce unnecessary admissions while enhancing quality of care, such that future readmissions would decrease in number, as well.

Critical to this strategy is not just adherence to timely follow-up schedules but the ability to efficiently determine which patients carry a risk of rapid recurrence that is low enough to warrant outpatient care. These needs drove the development of a pilot protocol that would aid ED staff in precisely that task, drawing on the evidence discussed above. Based on the $ABCD^2$ score and the results from imaging studies of the head and neck, as well as other considerations, like the patient's living situation, staff following the guidelines would arrive at one of three possible disposition recommendations: discharge the patient from the ED and follow up within 5 days; do the same but loosen the follow-up window to 7 days; or admit the patient to the hospital. Virtual TIA Clinic protocol also calls for documentation of measures that might not otherwise be included, the primary example being the $ABCD^2$ score. No study had been performed to assess the extent to which MGH ED practice was already consistent with the pilot protocol proposed.

In this study, medical records of patients who were seen in the MGH ED between December 20, 2011 and March 28, 2012 and diagnosed with TIA were reviewed to determine whether these patients had been triaged in a manner consistent with the pilot protocol described and whether their follow-up, if discharged from the ED, occurred within the appropriate time frame. The essential goal of the study was to validate the elements of the proposed protocol by comparing them to actual practice, and in doing so, learn more about opportunities to create value in care of patients presenting with TIA.

Since medical record review hinges on documentation, the question of protocol-consistent care is difficult to separate from the question of protocol-consistent documentation. The methodology will be explained in more detail below.

In conducting this study, the question to be answered was: did triage and follow-up care of patients seen in the MGH ED between December 20, 2011 and March 28, 2012 take place in a manner consistent with the proposed protocol for Virtual TIA Clinic referral, and were such processes documented appropriately?

As a student member of the team, I worked closely with Sylvia Roth, MBA and Lee Schwamm, MD to design the study. Sylvia Roth had been working for some time on Partners Care Redesign efforts, not limited to neurologic care processes. Dr. Schwamm had been involved in projects to improve care pathways in the neurology department. Each had helped to develop the Virtual TIA Clinic protocol. Once the methodology had been determined, my responsibility was to abstract all relevant data by review of electronic and paper medical records. I then synthesized, analyzed, and presented the relevant data in a report that I created at the time the study was performed, in the summer of 2012. Dr. Elizabeth Mort, Vice President of the MGH Center for Quality and Safety, was my supervisor and research mentor throughout this process, offering substantial guidance in the study design, data analysis, and write-up phases of the project. Dr. Mort also oversaw my involvement in other projects that summer, as part of the MGH Center for Quality and Safety.

Section 2: Methods

This study was a small N, pilot cross-sectional analysis of TIA treatment practice in the MGH ED.

Prior to the medical record review, fields of information to be abstracted were decided upon. These include the following:

- Registration date was collected given the relevance of the period during which data were collected.
- Age was collected given that it comprises part of the $ABCD^2$ score. One point was given if the patient's age was 60 years or greater.
- Blood pressure was collected given that it, too, is a component of the $ABCD^2$ score. One point was given for either a systolic blood pressure of at least 140 or a diastolic blood pressure of 90. Of note, the initial blood pressure recorded on nursing documentation was used to derive this component of the score.
- Clinical presentation, though more inherently subjective than age and blood pressure, is also a component of the $ABCD^2$ score. It is broken down as follows: two points given for unilateral weakness, one point for speech disturbance without weakness, and zero points for other symptoms. This information was gathered from the general ED and neurology consult notes.
- Duration of symptoms is also by subjective report but similarly critical to the score. If symptoms persisted for sixty minutes or more, two points were given; for any number of minutes between ten and fifty-nine, one point; and for less than ten minutes, zero points. This information was gathered from the general ED and neurology consult notes.
- Diabetes history, the final component of the score, was typically more straightforward to ascertain. One point was given if this history was present. This information was gathered from the general ED and neurology consult notes, as well.
- The $ABCD^2$ score was calculated from the five components described above.
- Sex was recorded in order to better understand the demographic characteristics of patients whose charts were included in this study.
- Race was recorded for the same reason as sex.

- Imaging modality information was collected, given its importance to the Virtual TIA Clinic Protocol in triaging patients. Both the date of the study and findings which affect protocol pathway were recorded. Modalities included plain magnetic resonance imaging; magnetic resonance angiography; computed tomography; and ultrasound; in combinations which varied on a case-by-case basis. The presence or absence on each modality of a symptomatic vascular lesion and/or acute ischemic lesion was recorded. Imaging study information was taken from the Radiology section of the Results application, and all studies pertaining to the brain and carotid arteries were included in the data abstraction process.

Dates between which cases would be sampled were arrived upon by compromise between two goals: to gather data from cases as recent as possible in order to understand current practices; and to provide for at least 90 days of potential follow-up time after the most recent case in order to accurately ascertain patient outcomes. It should be noted that the collection by phone call of 90-day follow-up data did not occur when this study was performed in 2012 and is thus excluded from this report. Ultimately, it was decided that cases would be drawn from ED intake dates from December 20, 2011 through March 28, 2012. All cases of patients who had been diagnosed with TIA, via ICD-9 code 435.9, were included in the review; this yielded 30 cases.

Medical records were reviewed electronically using the “Results” application of the CAS utility and specifying that “all data” should be displayed. This ensured access to information from all time points. Medical record numbers and ED registration dates were gleaned from the initial case list, which was generated before the record review process began.

In the event that notes were not identical in reporting on a particular parameter, information was taken from the note with more detail. For example, a rushed initial ED note might not have the same attention to the nature and duration of the symptoms as would a more methodical and deliberate neurology ED consult note. While this did reveal useful information about general ED documentation practices, it was felt that treatment in the clinical setting would be driven by the more comprehensive history gathered by the neurology consult, and that this information should therefore be used to assess the extent to which treatment was consistent with that suggested by the pilot protocol.

ED notes and neurology ED consult notes were analyzed to determine whether the patient had experienced more than one TIA leading up to their ED visit; whether they were experiencing at the time of their ED visit a new-onset atrial fibrillation; whether they were medically stable; whether there was a person at home to monitor their status; and whether they could travel to outpatient appointments. The purpose here of this information is to inform triage at the ED stage; unfortunately, this kind of information was not always carefully recorded.

Virtual TIA Clinic protocol recommendations for disposition were synthesized from calculated $ABCD^2$ score, imaging findings, and the data described in the previous paragraph. The protocol itself is as follows:

-$ABCD^2$ score to be calculated, and brain and carotid imaging studies to be performed, on all patients

-Imaging study combinations in order of preference:

-MR-DWI + CTA

-MR-DWI + MRA

-CT + CTA

-CT + IC US

-Based on $ABCD^2$ and imaging, patients are then triaged according to the following protocol:

-$ABCD^2$ = 6-7 ➔ admit

-Symptomatic vascular lesion (≥ 50% ipsilateral) OR acute ischemic lesion OR more than one TIA ➔ admit

-If neither of the above criteria is met

-$ABCD^2$ = 2-5 ➔ TIA clinic in 1-5 days

-$ABCD^2$ = 0-1 ➔ TIA clinic in 1 week

-Patients with the following issues should be admitted or stabilized regardless of $ABCD^2$ score and imaging results:

-New-onset atrial fibrillation

-Medical instability

-No one in the home available to monitor status

-Inability to travel to outpatient appointments

Actual treatment course was determined from the ED note and neurology ED consult note, as well as any admission note, if applicable. If actual care did not match protocol recommendations, the reason was also abstracted from these notes. Like interpretation of radiologic findings, this is another area of ambiguity, but the apparent reason could usually be gleaned relatively easily. Follow-up time intervals were calculated for patients who were discharged from the ED by examining the history of notes recorded in the Results application as well as the "Summary 2" section of the Patient Chart tab of the LMR application.

Completeness of documentation typically depended on evidence that the $ABCD^2$ score had been employed in the ED triage process. This was sought in the ED note and neurology ED consult note.

The history of notes in the Results application, as well as the Patient Chart in the LMR application, was consulted to ascertain whether the patient had been re-admitted to a hospital within 90 days of discharge. There are limitations to this method, as not all readmissions might be found in these electronic records, nor any record held at MGH. The aforementioned follow-up call component of this study was therefore considered important to such an outcome measure, though this did not actually take place, due to limited resources and changing care redesign strategy following the completion of this pilot study. For patients who were documented to have been readmitted, the primary diagnosis for this readmission was taken from the corresponding admission note in the Results application. Yet more subjectivity surrounds the question of whether or not the readmission was related to the index admission; a relationship was considered to exist if the primary diagnosis for readmission was cerebrovascular in nature and either resembled the index diagnosis in the symptoms it manifested or represented a reasonable progression of the index diagnosis.

A patient was deemed to have had a personalized risk profile and plan for reducing risk if specific documentation of such was provided in any of the discharge notes accessible through the Results application of the CAS utility.

Results

The thirty patients in this study had a mean age of 73, were twice as likely to present with high blood pressure as without (66.7%), often presented with unilateral weakness (60%), and typically had experienced symptoms between 10 and 60 minutes in duration (43.3%). About a quarter had histories of diabetes (26.7%). All of these factors contributed to a mean $ABCD^2$ score of 4.4. Patients were slightly more likely to be female (56.7%) and highly likely to be white (96.7%). A radiologic finding of just a symptomatic vascular lesion was more common than one of just an acute ischemic lesion (30% vs. 13.3%); half of patients had neither finding, and few had both (6.7%).

Considering other factors that affect protocol recommendations, about one third of patients reported having experienced more than one TIA episode leading up to their ED visit (36.7%). One third had no person at home to monitor their status. However, no patient was documented as medically unstable, nor was any noted unable to travel to outpatient appointments. And only one patient was diagnosed with a new-onset atrial fibrillation.

According to the protocol, with the considerations described above, 80% of patients should have been admitted. Also according to the protocol, 16.7% of patients should have been discharged, and all of those but one seen within five days. One patient did not undergo enough imaging studies for the protocol to be applicable.

Actual dispositions planned by attending physicians were slightly, but not substantially, more conservative. Of the thirty total patients, 86.7% were admitted, while the rest were discharged. Of those 4 patients discharged, just one was discharged without having been observed in the ED, and this patient was sent directly to the Massachusetts Eye and Ear Infirmary (MEEI). Patients who were discharged from ED observation were not considered to have been admitted. These patients' stays were coded as ED Observation. Patients admitted as inpatients and ultimated coded as either Inpatient or Observation patients (distinct from ED Observation) were considered to have been admitted. Of the three patients discharged from ED observation, two had documentation of follow-up visits; one was seen 4 days after discharge and one 30 days after discharge, the latter receiving follow-up phone calls in the days following discharge.

In our small sample, 20% (N=6) were not actually triaged in a way that would have been predicted using the Virtual TIA Clinic protocol alone. Three patients were admitted when the

protocol would have called for outpatient follow-up; 2 patients discharged when the protocol would have suggested admission; and 1 patient not given enough imaging studies for the guidelines to be applicable, as mentioned above. Please see table 1 below for patient characteristics and disposition information.

The 5 patients from the first two categories all had $ABCD^2$ scores of 4 or 5. Documentation of $ABCD^2$ score did not appear correlated to the value of the score (i.e. It's plausible that a patient with a particularly high or low score would be more or less likely to have it documented, but this was not obviously the case in this study). It should be reported, however, that only one third of patients had documentation of $ABCD^2$ score.

Discussion

Perhaps the most useful finding of this pilot study is that MGH ED patients diagnosed with TIA usually have a good reason to be admitted, even as far as the proposed Virtual TIA Clinic Protocol is concerned. While more than half presented with $ABCD^2$ scores of either 4 or 5, suggesting the possibility of rapid outpatient follow-up, fully one third had no one at home to monitor their status, for example. More than one third had experienced multiple TIA episodes in the time approaching their visit. More often than not, for one reason or another, these patients ought to be admitted, and they are.

While it might be expected that a protocol such as that discussed above would significantly reduce admissions, given the prevailing conservative wisdom that often dictates otherwise, this study did not show such an effect. Attending physicians only recommended that one more patient in thirty be admitted than the proposed protocol did.

Also important to note is that the reason for such similarity in numbers did not seem to be attending physicians' express reliance on the $ABCD^2$ predictor. Fully two thirds of patients didn't even have an $ABCD^2$ score documented at a point in their care when the protocol would have called for it.

This is not to say that a practice protocol would not be useful or would not affect care at all. As one might have expected, every inconsistency between protocol-generated and actual recommendations was seen in patients whose $ABCD^2$ scores were between 4 and 5, precisely the range verging on that which would have the protocol calling for admission (6-7). These patients' level of risk is ambiguous, and they require judgment calls. While they may lie, for that very reason, in precisely the hazy range in which protocol is least potent when confronted with doctors' wisdom, this might also be the range in which protocol effects the most change, that is, if those doctors believe in its validity.

Limitations

The limitations on this study are multiple. Electronic medical record review involves a degree of subjectivity, with particularly concerning areas noted in the methodology. Further, the number of patients examined in this study is relatively small. Perhaps even more concerning is that the study does not capture all of the patients to whom the triage protocol would be applicable if implemented, since it includes only those who were given an official, coded diagnosis of TIA. Surely, there were many more who presented with similar symptoms and followed similar paths of assessment and care, but were not, in the end, determined to have experienced a TIA proper.

With those critical points in mind, however, the study ought to offer a glimpse of what to expect if such a protocol were fully implemented. To that end, the study suggests that the protocol would not be an effective way to increase value by reducing unnecessary admissions. The retrospective application of the protocol to this set of cases did not produce a hypothetical admission rate materially different from the one actually generated by attending physicians.

Conclusions

Given that the proposed protocol was not explicitly in use during the time period examined, assessment of the extent to which TIA triage and follow-up protocol increases care value would require first its finalization and concrete implementation. This is not a simple task; the basic components, though, are already in use, at least to some degree. Imaging studies, though not always in compliance with order of preference by cost-effectiveness, were almost always complete enough for the protocol to be applicable. And the $ABCD^2$ score is clearly employed for risk stratification in a significant number of patients. With the protocol in place, a value assessment would also require the measurement of outcomes. Those caveats now stated, and others noted above, this study did not suggest what the architects of the triage and follow-up protocol might have hoped it would, namely, that its implementation would reduce admissions from the MGH ED of patients diagnosed with TIA. That finding may represent appropriate care – that none of the admissions was unnecessary. It is also possible, however, that a refined protocol with higher barriers to admission would preserve, or even improve outcomes, while reducing costs at the same time.

Suggestions for Future Work

Future studies might very well examine the impact of a protocol more aggressive in shuttling patients toward the outpatient route of care. Again, full implementation and outcomes data would be desirable.

If such a study were to be performed, investigators would do well to consider the coding of patients when delineating their study population. As mentioned earlier, this study did not capture an important group of patients, applied to whom the hypothetical protocol may have been apparently effective in reducing initial admissions: those who present to the ED with TIA-like symptoms but who are not ultimately diagnosed with such. Unfortunately, it is difficult to design a study which targets this group, precisely because there is no code to denote it. Efforts were underway at the time this study was performed to craft unique order-sets, if not administrative codes, that would allow investigators to examine this group.

The results of this study should also prompt us to consider the practical challenge of enforcing adherence to any kind of protocol or guidelines, which is not at all trivial. Setting aside for a moment the finer points of a scoring and triage system, how should we venture to make it a part of a clinical team's workflow?

Given the extent to which the electronic medical record influences clinical processes, the interface with such would be a high-yield place to start. While the tail may be wagging the dog – clinical processes should ostensibly shape EMR architecture, not the other way around – we may as well acknowledge the perversion and put it to good use. This is already done in the form of pop-up warnings and suggestions that guide clinical decision making, to varying effect.

A solution could lie in software which recognizes patterns that suggest possible TIA/stroke in the patient in question, patterns which would likely be easiest to recognize in orders, given their discrete, structured nature. The homegrown Queriable Patient Interface Dosssier (QPID) could also be used to great effect in recognizing patients of interest based simply on free text entered into note-taking fields. However these patients are recognized, such recognition could prompt the clinician to fill out a simple template representing the scoring method, at which point the result would be tabulated with an attendant explanation of the ramifications, including suggestions for triage. As with other computer-aided clinical decision-making tools, the application could allow the clinician to deviate from this suggestion, of course,

but would request a brief justification. This query could also be presented in multiple choice format, less likely to be dismissed.

Whatever direction is taken in research or implementation, there ought to be an emphasis on thoroughness and consistency in documentation of assessment and care of TIA patients. If attending physicians in the MGH ED usually employ the $ABCD^2$ score, it is not clearly so. If patients always receive a personalized risk profile and plan for risk reduction, that, too, is not made clear in the electronic medical record. To put the matter philosophically: if a risk stratification score is calculated in a hospital, but nobody records it, was it ever calculated at all?

Tables

Table 1: Patient Characteristics and Disposition			
		n	**percent of total**
Age	40-49	3	10
	50-59	3	10
	60-69	5	16.7
	70-79	8	26.7
	80-89	7	23.3
	90-99	4	13.3
mean	73		
blood pressure (first measured on presentation)	≤140 systolic and ≤90 diastolic	10	33.3
	>140 systolic and/or >90 diastolic	20	66.7
clinical condition	speech disturbance without unilateral weakness	7	23.3
	unilateral weakness	18	60
	other symptoms	5	16.7
duration	<10 minutes	5	16.7
	≥10 minutes and <60 minutes	13	43.3
	≥60 minutes	12	40
history of diabetes mellitus	yes	8	26.7
	no	22	73.3
sex	Male	13	43.3
	Female	17	56.7
race	White	29	96.7
	Black	1	3.33
ABCDD score	0 or 1	1	3.33
	2 or 3	5	16.7
	4 or 5	16	53.3
	6 or 7	8	26.7
mean	4.4		

Radiologic findings (on at least one modality)	symptomatic vascular lesion only	9	30
	acute ischemic lesion only	4	13.3
	neither	15	50
	both	2	6.67
number of TIA episodes	1	19	63.3
	>1	11	36.7
medical stability	medically stable	30	100
	medically unstable	0	0
new-onset atrial fibrillation	present	1	3.33
	absent	29	96.7
person in the home to monitor status	present	20	66.7
	absent	10	33.3
ability to travel to outpatient appointments	able	30	100
	unable	0	0
Disposition recommended by guidelines	discharge	5	16.7
	admit	24	80
	imaging insufficient to determine recommendation	1	3.33
Disposition planned by attending	discharge	4	13.3
	admit	26	86.7
Guideline adherence	admission planned when discharge recommended	3	10
	discharge planned when admission recommended	2	6.67
	admission planned when admission recommended	22	73.3
	discharge planned when discharge recommended	2	6.67
	imaging insufficient to determine recommendation	1	3.33

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